NASA-JSC Safety and Mission Assurance

NC/Space Exploration Division

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Subject: Project Abstract

Mass and Reliability Source (MaRS) Database

Overview

The Mass and Reliability Source (MaRS) Database consolidates components mass and reliability data for all Oribital Replacement Units (ORU) on the International Space Station (ISS) into a single database. It was created to help engineers develop a parametric model that relates hardware mass and reliability. MaRS supplies relevant failure data at the lowest possible component level while providing support for risk, reliability, and logistics analysis.

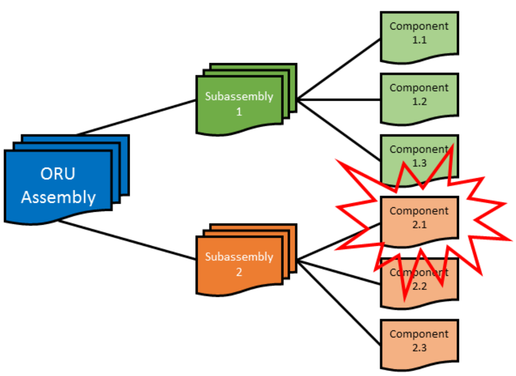

Figure 1. MaRS Overview

Random-failure data is usually linked to the ORU assembly. MaRS uses this data to identify and display the lowest possible component failure level. As seen in Figure 1, the failure point is identified to the lowest level: Component 2.1. This is useful for efficient planning of spare supplies, supporting long duration crewed missions, allowing quicker trade studies, and streamlining diagnostic processes.

MaRS is composed of information from various databases: MADS (operating hours), VMDB (indentured part lists), and ISS PART (failure data). This information is organized in Microsoft Excel and accessed through a program made in Microsoft Access (Figure 2).

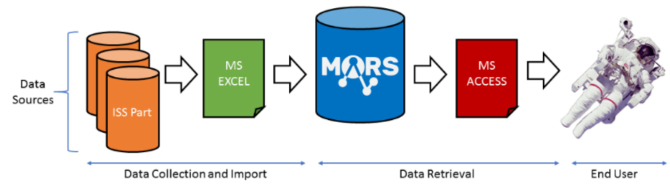

Figure 2. Database Schematic

Duties

The focus of the Fall 2017 internship tour was to identify the components that were the root cause of failure from the given random-failure data, develop a taxonomy for the database, and attach material headings to the component list. Secondary objectives included verifying the integrity of the data in MaRS, eliminating any part discrepancies, and generating documentation for future reference. Due to the nature of the random-failure data, data mining had to be done manually without the assistance of an automated program to ensure positive identification.

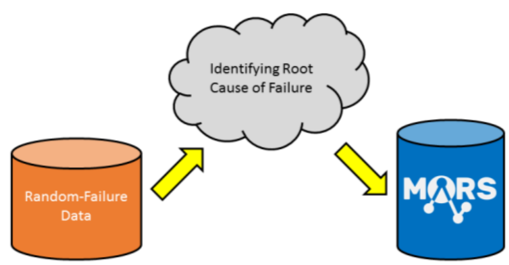

Figure 3. Data Mining

Accomplishments

Over 150 components were sucessfully identified as the root cause of failure from the random-failure data. These components were then cross-referenced to their respective part numbers and added to MaRS. The integrity of the database was also checked; missing ORUs were added and irrelevant failure data removed. Development of a taxonomy also began. Finally, documentation was generated for future interns to use.

Improvements

While data mining, it was noticed that some of the random-failure data was either irrelevant or unusable. The data was technically sound, but it was not subjectively relevant to the scope of the database. A statistical analysis was conducted to discover if a trend was developing. Using a normalized distribution curve, it was found that the unusable reports were not distributed evenly; the data set was skewed to the right. The mode of the dataset was 2011. It was concluded that the data published after this year tended to be irrelevant to MaRS because the root cause of failure wasn't distinctively clear. Therefore, a cutoff date limit was introduced to MaRS in order to increase data fidelity.

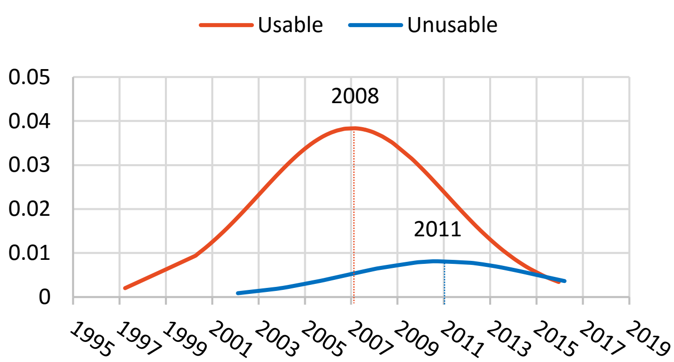

Figure 4. Density Distribution of Usable/Unusable Reports

Impact of Internship

NASA's concept of *lessons learned* goes as follows: "A lesson learned is knowledge or understanding gain by experience… [A lesson] reduces or eliminates the potential for failures and mishaps, or reinforces a positive result." The entirety of the internship tour revolved around this concept. My mentors, the men and women who make up NASA, were constantly sharing knowledge of their past experiences with me. In their own way, they allowed for me to learn from their experiences and use their perspectives to work on my project, and conduct myself in day-to-day instances. The people at Johnson Space Center were the shoulders of giants I stood on to further develop myself professionally. The guidance alone is an invaluable impact done by this internship.

This internship also developed and reinforced technical skills such as statistical analysis, coding, and data mining. Coming from a background of Mechanical Engineering, the curriculum I went through had very minimal coding applications to it. The MaRS project utilized what I knew as a foundation to coding and expanded it into workable knowledge in which I could apply to the project. This allowed me to stray outside of my comfort zone and undertake a project heavily based in coding. Furthermore, I learned certain statistical techniques to prove my findings; data is nice to have but necessary to validate.

Working in the Risk and Reliability Analysis Branch of S&MA gave me a newfound appreciation to the type of work done by the Probabilistic Risk Assessment, Data Analysis, and Reliability Analysis Team. The team can accurately track possible failure scenarios and predict to when they will occur. This type of foresight is indispensable for Human Spaceflight.

Those at Johnson Space Center all have one thing in common: a true love for Space Exploration. With a goal of eliminating the unknown and progessing Human Knowledge, the men and women of JSC are truly the spearhead for space travel. It takes a maximum amount of effort to launch Humans in a controlled explosion and unto the cosmos. It takes even more effort to bring them back safely. All this cannot be done without the employees of NASA.

This internship solidified my interest in Space Exploration. It allowed me to be a firsthand witness to the awe-inspiring spirit of Human Curiousity. It embolden my technical skills and knowledge, while giving me direction to become the person I want to be. It showed me that behind every Neil Armstrong and John Glenn, there's a multitude of important individuals all supporting the same cause. It made me to stay technically proficient in my field, and be humble and helpful with others. The exploration of Space is not robotic, it's a Human venture. The lessons learned at NASA will be lessons I will forever carry throughout my lifetime.